FAST ■ EASY ■ ACCURATE

AquaChek®

Pool & Spa Testing™

SELECT® CONNECT TEST STRIPS KIT

EXPERT RESULTS POOLSIDE FOR 7 MOST IMPORTANT CHEMISTRIES

FREE Dip & Scan Smart App + Complete Pool & Spa Care Guide

Kit Includes:

- *Innovative Smart Phone App with Dip & Scan Technology*
- *Complete Pool & Spa Care Guide from our water quality experts*
- *7-in-1 test strips supporting App photo capture or manual read*
- *Reusable UV and water-resistant color chart*

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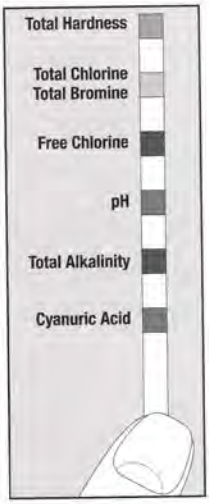
AquaChek® Pool & Spa Testing™

AquaChek® Select Connect App is the fast, easy, and accurate way to check seven pool parameters with a single strip; and now with the The AquaChek Select Connect App, it has never been easier to pick color blocks and receive dosing recommendations. Within seconds you can know the levels of total hardness, total chlorine (or total bromine), free chlorine, pH, total alkalinity, and cyanuric acid with a tap of your finger.

Testing your pool or spa often to keep the water fresh and sparkling clean is crucial. It is recommended that you test your pool twice weekly even when the swimmer load is low. As the use of the pool increases, testing should be done more often to ensure the water is properly balanced and an appropriate level of sanitizer is maintained. Imbalances in the pool chemistry can occur rapidly. For example, two people in a 400-gallon (1.5 kL) spa will consume 1 ppm (part per million, equivalent to mg/L) of free chlorine in the first 15 minutes of use.

If imbalances are detected after testing, the AquaChek Select Connect App can provide chemical dosing recommendations, or this booklet contains recommendation charts to assist with re-balancing. All chemicals outlined in the app or within this booklet are described by their common names and are available at local retailers who carry pool and spa products. Although commonly packaged under a brand name, the common chemical name will also be listed on the label, usually as the 'active ingredient.' **See the 'Warnings for Handling Chemicals' section in this booklet before treating the pool or spa.** Also, consultation with a local pool and spa professional for treatment advise and recommendations is encouraged.

The AquaChek Select Connect Test Strip



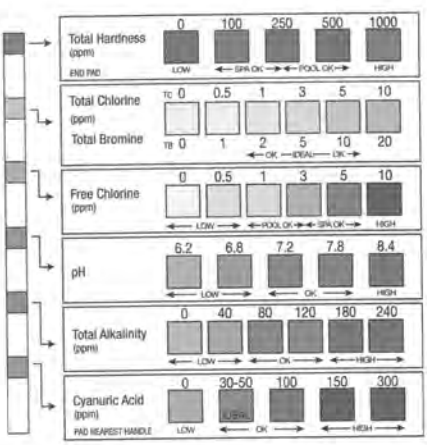
AquaChek Select Connect tests the total hardness, total chlorine (or total bromine), free chlorine, pH, total alkalinity, and cyanuric acid levels simultaneously. Each parameter listed is tested by one of the six unique pads on the strip. The chemistry for each parameter was carefully designed to provide a range of unique colors for the conditions typical for pools and spas. The color generated on a pad after dipping the strip represents a specific value that can be determined with the color chart or The AquaChek Select Connect App.

Note: Water and humidity contamination of the strips can reduce their accuracy. To mitigate the effects of moisture, a desiccant pouch is included in the bottle and should not be removed. Hands should be dry before removing strips from the bottle and the bottle cap should be securely tightened whenever the product is not in use. Additionally, the test strips should be stored in a relatively cool and dry location, not in direct sunlight, nor with pool chemicals. Following these guidelines will maintain the test strip performance throughout the shelf life printed on the bottle.

Reading the Test Strip

AquaChek Select offers two options to collect a reading from your test strips: the physical color comparator and the AquaChek Select Connect App. The comparator has six rows of color blocks which correspond to the six pads on the test strip. Once the strip is dipped, matching the color generated in the test strip pad to the color comparator will give the level of that parameter within the pool or spa.

The color comparator is reusable and should last for several seasons. Once the bottle of test strips in the comparator are depleted, an AquaChek Select Connect Refill can be purchased to replenish the test strips without acquiring an additional color comparator. The refill bottle comes with 50 new test strips that can be used with either the color comparator or the AquaChek Select Connect App.



The AquaChek Select Connect App

AquaChek now offers the AquaChek Select Connect App for free download (iOS and Android). This AquaChek Select Connect App will not only select color blocks using photo-capture technology, but it will provide recommendations, answers to frequently asked questions, and store previous testing so trends can be displayed and tracked.

Setting up the App

Once the app is downloaded on the desired device, it will request information regarding the system being tested. To provide relevant results and accurate recommendations, a selection must be made between whether a pool or spa is being tested. Next, the volume of the pool or spa needs to be entered along with the sanitizer used (chlorine or bromine). The app will guide the user through these steps and provide a tool to calculate the volume of the pool or spa based on its dimensions as well as explanations of different chlorine types. Once this information is inputted, the app will retain the specifications and will not ask for them again. However, the information can be changed or updated in the settings at any time. Since this initial setup will take some time, it is recommended that the one-time setup be completed before testing.

How to use the App

Once the pool or spa parameters are set, the Test screen presents two options: Photo Capture or Manual Entry.

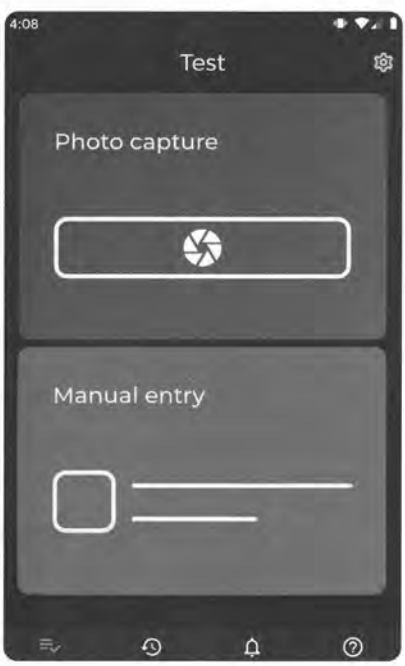
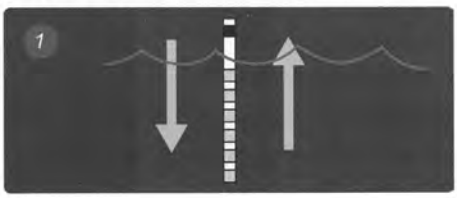


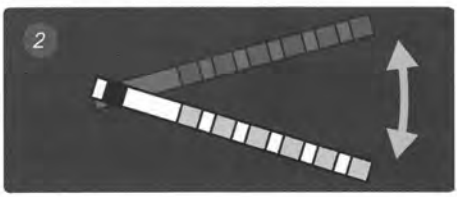
Photo Capture

The first time the photo capture is used, the app will display the steps and instructions to successfully capture the image of the test strip.

1) Dip the drip into the water and quickly remove



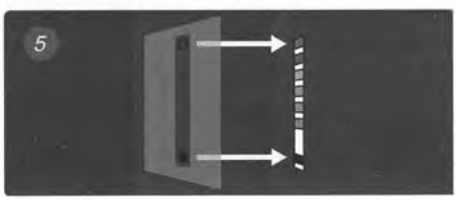
2) Gently shake off excess water



3) Place strip on the grey background of the plastic comparator

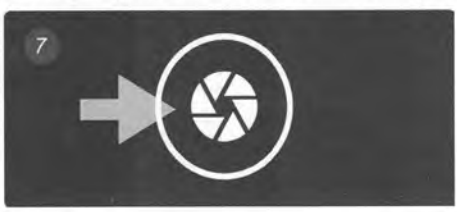
4) Wait for the 15 second timer within the app to expire before taking a picture

5) Line the ▭ and ▬ markers up with the first pad and the black square on the strip



6) After 15 seconds, the camera will automatically take a picture if Autocapture mode is on

7) You can tap the camera button to take an image at anytime as long as the test strip window outline is green



After the first photo capture test, these instructions will not automatically show again. However, these steps and instructions are available at any time within the 'Help' tab in the lower right corner of the app screen entitled 'Photo capture help.' Once the 'Ok' button is selected the app will request access to the device's camera. If permission is granted, this text box will not appear again.

During photo capture, the test strip window will be outlined in colors indicating whether the test strip is in focus and lined up correctly. If the outline is red, it indicates that the strip is not being read. If yellow, the strip is lined up correctly; but not optimally. If green, the strip is lined up correctly and the camera is focused.

Once 15 seconds has passed and the outline is green, an image will automatically be captured if the Autocapture mode is turned on. An image can manually be captured at any time if the strip window outline is green, but to ensure accurate readings and results an image should only be captured 15 seconds after dipping the strip.

Once an image is captured, the app will populate a review page which shows the selected color block values calculated for each parameter. Each parameter is editable, so if the user disagrees with the calculated value, the 'Edit' button can be used to select a new color block. Selecting the 'Save' button will log the entry and generate a results page.

Manual Entry

Along with photo capture, the app allows the user to manually input the values of a strip with the Manual Entry option from the Test page. Selecting the Manual Entry option will open a blank test strip. Clicking the 'Edit' button for each parameter will allow the user to select the appropriate color block. **It is important to use the physical color chart on the comparator for color block determination. The physical color chart was designed and developed for reading test strips directly. Colors can appear different digitally depending on the unique screen settings.** Once a color block is selected for each parameter, selecting the 'Save' button will log the entry and generate a results page.

Results

The Results page is unique for each test. Each parameter will list the recommended range for that parameter. If a value is outside the recommended range for a given parameter, an alert will be given along with a prescription to bring that parameter back into range. If further information is desired, each parameter has a 'learn more' button. From this Results page, the testing results and prescriptions (if necessary) can be emailed or printed if a printer is added to the device. The Results page also allows the ability to delete results from the app for any given test.

History

The app holds all logged tests in the History tab. Each test is titled with the day, month, year, and time it was taken. Any saved test can be accessed here whenever desired. Along with the list of all saved tests, this page displays a graph showing the latest ten tests for each of the parameters tested. Parameters can only be shown individually and are selected by the corresponding button above the graph.

Reminders

It is recommended that pools be tested twice per week. However, depending on the swimmer load and sunlight and temperature exposure, more frequent testing may be necessary. For spas, it is recommended that testing occur before and after each use due to the high temperature and low volume. The app offers the ability to set reminders for testing, so it is not overlooked.

Help

The Help tab, like the History and Reminders tabs, can be accessed at any time. It provides answers to some frequently asked questions, all instructions and information shown during initial setup, along with an AquaChek retail finder.

How to Calculate Total Volume of Your Pool

To use the treatment charts in this booklet, you will need to know the volume of your pool. This volume can be easily calculated with the AquaChek Select App, the AquaChek Smart App, or the calculator on AquaChek.com. However, a digital methodology is not required, and the calculation is relatively simple.

Example: The pool is 27 ft (8.23 m) long, 15 ft (4.6 m) wide, 8 ft (2.4 m) deep at the deep end, and 2 ft (0.6 m) deep at the shallow end.

Step 1: Calculate the average depth. Add the deep end and shallow end depth measurements together then divide the result by 2.

8 ft + 2 ft = 10 ft (metric: 2.4 m + 0.6 m = 3.0 m)

10 ft ÷ 2 = 5 ft (metric: 3.0 m ÷ 2 = 1.5m)

Step 2: Calculate the total volume. Multiply the average depth by the length of the pool and then the width of the pool.

5 ft x 27 ft x 15 ft = 2,025 ft3 (metric: 1.5 m x 8.23 m x 4.6 m = 56.8 m3)

Step 3: Convert to gallons. Multiply by 7.5 to get gallons. No further calculation is needed in metric units.

2,025 ft3 * 7.5 gal/ft3 = 15,188 gal (metric: 56.8 m3 = 56.8 kL)

Step 4: If the treatment chart found in this booklet is to be used for dosing, round to the nearest 1,000 gal or nearest kL.

15,188 gal = 15,000 gal (metric: 56.8 kL = 57 kL)

For round/oval pools: If the pool/spa is round or oval, multiply the diameter (one direction across the center) by the diameter (other direction across the center) by the average depth. Then multiply this value by 5.9 to give the water volume in gallons. For metric units, multiply by 0.785 for metric volume.

Example: A round pool measures 20 feet (6.0 m) in one direction across the middle, 20 feet (6.0 m) in the other direction across the middle, and has an average depth of 5 feet (1.5 m).

20 ft x 20 ft x 5 ft x 5.9 gal/ft3 = 11,800 gal
(metric: 6 m x 6 m x 1.5 m x 0.785 kL/m3= 42.7 kL)

As with the square/rectangular pools, round to the nearest 1,000 gallons or kL if the treatment chart in this booklet is to be used for dosing.

Basic Pool and Spa Water Chemistry

Total Hardness

Total hardness refers to the amount of calcium and magnesium ions present in pool and spa water. If the levels of total hardness exceed 500 ppm (hard water), scale can begin to form which can increase cloudiness in the water and potentially clog plumbing, filters, and heaters. Conversely, total hardness levels below 250 ppm (soft water) are corrosive and therefore can damage plaster walls and metal fixtures. The recommended range for total hardness in pools and spas is between 250 and 500 ppm.

Chlorine

The purpose of a pool or spa disinfectant is to sanitize (kill all living organisms), disinfect (kill all disease-causing organisms), and oxidize (destroy swimmer waste, ammonia, and other nitrogen-containing contaminants). A disinfectant must always be present in the water (also referred to as sanitizer residual) to react instantaneously with any bacteria, algae, and other organic matter introduced. Providing this measurable sanitizer residual to the water is critical for any disinfectant to ensure swimmer safety.

Chlorine is the most common disinfectant used for this application. The amount of chlorine that your pool or spa requires to eliminate contaminating materials is called chlorine demand. The chlorine that is active and able to sanitize and oxidize

contaminants is referred to as free chlorine residual. Chlorine that has already reacted with contaminants throughout sanitation is called combined chlorine. Total chlorine is the sum of both free chlorine residual and combined chlorine. Periodically, more chlorine will need to be added to pools or spas to maintain an optimum level of free chlorine residual to sanitize/oxidize new contaminants being introduced. The recommended range for free chlorine residual in pools is between 1 and 3 ppm (mg/L), and between 3 and 5 ppm for spas.

When the free chlorine residual reacts with contaminants (the process of sanitizing), it becomes combined chlorine. An over-abundance of combined chlorine causes eye irritation and strong, sometimes offensive, chlorine odors. Often it is thought that the strong offensive smell associated with pool and spas is caused by an overabundance of chlorine. However, it is actually a lack of the sanitizing free chlorine and an overabundance of the combined (spent) chlorine.

When the total chlorine level in the pool or spa is higher than the free chlorine levels, superchlorination or 'shocking' is required. Superchlorination or shock treatments are required more frequently when pool water temperatures are high or heavy swimmer loads occur. Superchlorinating, or shock treating, a pool or spa is adding excessive chlorine (free chlorine) to raise the free chlorine residual to 10 ppm for at least 4 hours. This excess of free chlorine can further oxidize the combined chlorine to a point where these compounds become gaseous and leave the pool. Alternatively, shock treating can be carried out with potassium monopersulfate (non-chlorine shock treatments). Non-chlorine shock treatments will consume the organic contaminants, but will not sanitize like chlorine. Consult a pool dealer/professional if potassium monopersulfate is to be used.

Total Bromine

Bromine is another popular type of disinfectant, used primarily in spas. Bromine is often the disinfectant of choice for spas since it is more effective and stable than chlorine at the high temperatures and higher pH ranges associated with spas. Additionally, combined bromine does not produce the offensive odor that combined chlorine does. However, bromine is not ideal for outdoor pools and spas due to its sensitivity to UV degradation from the sun. Bromine is very quickly destroyed by strong sunlight which could leave the water with no residual disinfectant. Also, bromine cannot be stabilized with cyanuric acid to protect from UV degradation like chlorine can. Therefore, bromine is only used in indoor pools and hot tubs (or in hot tubs that remain covered when not in use).

Unlike chlorine, the combined form of bromine is still an effective sanitizer. Combined chlorine (spent or consumed free chlorine) can no longer act as a sanitizer, however combined bromine is still capable of sanitizing and disinfecting.

Therefore, total bromine is measured to indicate the sanitizer residual for bromine systems and not free bromine. The recommended range to maintain total bromine levels is 3 to 5 ppm for indoor pools and 4 to 6 ppm for spas.

Total Alkalinity and pH

Total alkalinity is a measure of alkaline compounds (primarily bicarbonates and carbonates) in water. Alkaline substances buffer your water against sudden changes in pH. They have a limited ability to cancel out additional acidic and basic compounds added to the water. Keeping the pH consistent is important for both swimmer comfort and maintenance of the pool or spa. Lower pH values (<7.0) can be particularly damaging and corrosive to pool fixtures, liners, plumbing, and equipment. It is recommended to keep the total alkalinity levels between 100 and 120 ppm (parts per million) if sodium dichlor, trichlor, or bromine is being used as the sanitizer. If a chlorine sanitizer that does not contain cyanuric acid is used (calcium, sodium, or lithium hypochlorite), the total alkalinity levels should be between 80 and 100 ppm.

pH is the measure of acidic and alkaline materials in water. It is a scale that ranges from 0 (extremely acidic) to 14 (extremely basic). A pH of 7.0 is considered neutral, neither acidic nor basic. It is recommended that the pH of pools and spas be restricted within the range of 7.2 to 7.8 for both sanitizer efficiency and swimmer comfort. If the pH rises much above 7.8, the sanitizer in the pool becomes less active and the water may become more irritating to skin and eyes. If the pH drops much below 7.2, the water will become more acidic which can cause skin and eye irritation along with potential corrosion and damage to the pool fixtures, liners, plumbing, and equipment.

Cyanuric Acid

Cyanuric acid, also called 'stabilizer' or 'conditioner,' increases the stability of free chlorine to UV radiation from the sun. In the presence of cyanuric acid, free chlorine goes back and forth between binding to cyanuric acid and being unbound in the water. When bound to cyanuric acid, UV radiation cannot degrade free chlorine. So, the presence of cyanuric acid increases the length of time free chlorine remains in the pool or spa in terms of UV degradation. Without cyanuric acid, it is possible for a pool in full sun to have the free chlorine concentration drop from ideal levels to zero within several hours. However, if the cyanuric acid levels are too high, it will bind the free chlorine too much, limiting its effectiveness as a sanitizer. It can also increase the total dissolved solids (TDS) and clarity of the water. If cyanuric acid is desired for free chlorine stabilization, the recommended range is between 30 and 50 ppm. Some health departments set the maximum cyanuric acid level of 100 ppm.

There are several chlorine additives, dichlor and trichlor (see 'learn more about chlorine types' in app Help tab), that add cyanuric acid alongside free chlorine. This eliminates the need for two separate additives. However, unlike free chlorine that will degrade in UV radiation and in the process of disinfecting the pool or spa, cyanuric acid does not degrade and there are no additives available that can decrease its level in pools or spas. If combination chemicals like dichlor and trichlor are used, it is imperative to monitor the cyanuric acid levels. The only way to decrease cyanuric acid levels is to either partially or fully drain the pool and refill with fresh water.

Follow These Easy, Single Dip Instructions:

Remove an AquaChek Select Connect test strip from the bottle and replace the cap. Dip the test strip into your pool or spa and remove immediately.

- If using the app, hit the 'Photo Capture' button on the Test page and place the test strip on the grey background provided with the comparator. Once the timer completes its 15 second countdown, press the camera button if the strip outline is green. If the strip outline is not green, better alignment of the test strip is required for accurate results. If Autocapture mode is on, the photo will be captured automatically once the timer expires and the test strip outline is green.
- If using the color chart on the comparator, hold the strip level, pad side up, for 15 seconds.

Immediately make color comparisons, as follows:

Total Hardness *(end pad)*
Total Chlorine *(or Total Bromine)*
Free Chlorine
pH
Total Alkalinity
Cyanuric Acid *(pad nearest handle)*

Estimate the result if color on test pad falls between two color blocks.

Note: For best results on the cyanuric acid test, pH should be between 7.0 and 8.4, and total alkalinity should be at or below 240 ppm.

Test Log Results

If using the app, the results will be logged once 'Save' is selected on the Results page. The app will also provide treatment recommendations based on the dimensions for the pool/spa inputted during initial setup along with the chosen chlorine type.

This booklet also contains a Test Log section on the last pages. Once testing is complete, write down the results in the Test Log. Now consult the Treatment Recommendation Charts on the following pages to determine how to obtain proper pool or spa water balance.

Analyzing Test Results and Adjusting Pool Water

In the preceding sections testing methods were described. The following section will lay out methodologies to interpret test results and achieve water balance if the app is not used. Maintaining pool and spa water quality requires balancing several parameters simultaneously.

Water Balance

Additional water will eventually be introduced to the pool or spa. This water may be added intentionally or through rain. Water (whether it is from rain, a well, or city municipality) can have a wide range of dissolved minerals depending on the surrounding environment. For pools and spas, water can fall into roughly three categories:

- Water can be under-saturated: such water may also be described as aggressive or corrosive.
- Water can be saturated: such water may also be described as at equilibrium, balanced, or neutral.
- Water can be over-saturated: such water may also be described as scale-forming.

Water that is under-saturated (corrosive), may cause etching and pitting of concrete and plaster lined pools. It may also lead to staining, skin and eye irritation, and vinyl liner wrinkling.

Water that is saturated (neutral), has an appropriate dissolution of minerals for a pool or spa environment and will not have any effect on equipment or hardware.

Water that is over-saturated (scale-forming), will deposit excess mineral content on the pool and equipment in the form of scale.

Of all the minerals found in and around a concrete pool, calcium is the most abundant and the one most likely to be dissolved by corrosive water. At the same time, calcium carbonates are the most likely form of scale to be deposited within the pool and equipment. However, just knowing the calcium concentration (while a large part) is not the only factor determining whether water is corrosive, neutral, or over-saturated.

In 1936, a man named Wilfred F. Langelier devised an index for predicting which state a given water is in. Through experimentation, Langelier discovered that five factors influence calcium carbonate precipitation. The pH, temperature, alkalinity, calcium hardness, and total dissolved solids (TDS) all determine whether a particular water would strip calcium out of a pool/spa or deposit it in the form of scale.

Langelier assigned a value to each of these variables and developed a formula to determine the scale-forming properties of the water. His original intention was to develop a function to determine the scale-forming tendencies but discovered that this method could also determine the corrosiveness (tendency to strip calcium from the surroundings) of water.

Other predictive indices have been developed as well. A detailed discussion of Langelier's approach and other similar indices is beyond the scope of this booklet. Some of the test procedures required for Langelier's calculations are best performed by a pool professional. A homeowner can usually keep his pool in adequate balance by using the simpler approach described below. For extreme cases, where the pool is far out of balance, a visit to a local pool professional or consultation with a service person may be required.

Water Adjustments

In establishing its standards for public and residential pools and spas, The International Aquatic Foundation (IAF) and National Spa & Pool Institute (NSPI) have developed a set of guidelines for chemical maintenance of water quality. These "Chemical Operation Parameters" were designed specifically for the pool and spa industry as a method for maintaining water quality without relying on any of the established indices, such as Langelier index.

If the NSPI chemical guidelines are followed and calculate the values using one of the established indices, the water will be in balance according to the calculated index value.

Below are the IAF/NSPI chemical standards for reference.

APSP Standards for Pools and Spas (2011 Operational Parameters)			
	Minimum	Ideal	Maximum
Free Chlorine, ppm	Pool: 1.0	Pool: 2.0 - 4.0	None given
	Spa: 2.0	Spa: 2.0 - 4.0	None given
Combined Chlorine, ppm	0.0	0.0	Pool: 0.2
	0.0	0.0	Spa: 0.5
Bromine, ppm	Pool: 1.0	Pool: 3.0 - 4.0	None given
	Spa: 2.0	Spa: 4.0 - 6.0	None given
pH	7.2	7.4 - 7.6	7.8
Total Alkalinity, ppm	60	80 - 100 * 100 - 120 **	180
Calcium Hardness, ppm	Pool: 150	Pool: 200 - 400	Pool: 500 - 1000 ***
	Spa: 100	Spa: 150 - 250	Spa: 800
TDS, ppm	N/A	N/A	1500 over start-up TDS †
Cyanuric Acid (or Stabilizer), ppm	10	30-50	100 ††

* = for calcium, sodium, and lithium hypochlorite

** = for dichlor, trichlor, and bromine compounds

*** = This depends on the local fill water conditions. Normally, 500 ppm is the maximum

† = salt pools with a chlorine generator will have higher TDS levels, but most health departments limit the initial TDS levels to of additional fill water to 1500 ppm regardless of whether addition TDS will be added for a salt system

†† = 100 ppm cyanuric acid is commonly set as the maximum, however this can vary per state and local health code

Adjusting the Water

To adjust water, first the current state of the water needs to be assessed through testing. Once the level of all the parameters is known, adjustments can be made. The following sections will outline how to balance each parameter along with treatment recommendations for all critical parameters/additives required for a safe, balanced pool or spa.

There are five parameters that effect the water balance (e.g. Langelier index): TDS, temperature, total hardness, pH, and alkalinity.

- Total Dissolved Solids (TDS) can be changed easily by draining water and refilling, but altering TDS has a relatively small impact compared to the other four parameters.
- Temperature has a fairly large impact, but pools are kept in a fairly constant temperature range.

- Total hardness can have a large influence on water balance, but it is the most difficult to change if it needs to be lowered or if the source water is high in calcium.

So, three of the five parameters in the Langelier Index can be regarded as essentially fixed. The only parameters that change regularly are pH and alkalinity — they have a large impact on water balance, and they are easy to change. Therefore, they are the most common adjustments made.

The water parameters in pools and spas should be balanced/prioritized in the following order:

- Total Hardness
- Alkalinity
- pH
- Free Chlorine / Total Bromine
- Cyanuric Acid

Total Hardness

Before attempting to balance pool or spa water, a minimum level of total hardness needs to be established. There is debate on the specific amount, but it is generally agreed that the minimum amount of total hardness ought to be in the range of 150 and 175 ppm (i.e. between the 100 and 250 ppm color blocks). If the source water is low in calcium, the level can be increased by adding calcium chloride ($CaCl_2$). As a general rule, 1 pound (454 g) calcium chloride added to 10,000 gallons (38 kL) of water will increase calcium hardness by 8 ppm (parts per million).

The chart below can aid in determining how much calcium chloride must be added to pools or spas to attain a certain level of hardness based on the volume of water. For example, to raise the hardness 20 ppm in a 15,000-gallon (57 kL) pool, correlating the correct column and row shows that 3.75 pounds (1.7 kg) of calcium chloride needs to be added.

Raising Hardness With Calcium Chloride

See warnings for handling chemicals on page 25

Increase In Hardness In ppm	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal. 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
10	2 oz. 56.7 g	10 oz. 283 g	1 1/8 lbs. 568 g	1 3/4 lbs. 795 g	2 1/2 lbs. 1.1 kg	3 1/4 lbs. 1.5 kg	6 1/4 lbs. 2.8 kg
20	4 oz. 113 g	1 1/4 lbs. 568 g	2 1/2 lbs. 1.1 kg	3 3/4 lbs. 1.7 kg	5 lbs. 2.3 kg	6 1/4 lbs. 2.8 kg	12 1/2 lbs. 5.7 kg
30	6 oz. 170 g	1 3/4 lbs. 796 g	3 3/4 lbs. 1.7 kg	5 1/2 lbs. 2.5 kg	7 1/2 lbs. 3.4 kg	9 1/2 lbs. 4.3 kg	18 3/4 lbs. 8.5 kg
40	8 oz. 223 g	2 1/2 lbs. 1.1 kg	5 lbs. 2.3 kg	7 1/2 lbs. 3.4 kg	10 lbs. 4.5 kg	12 1/2 lbs. 5.7 kg	25 lbs. 11.4 kg
50	10 oz. 283 g	3 lbs. 1.4 kg	6 1/4 lbs. 2.8 kg	9 1/2 lbs. 4.3 kg	12 1/2 lbs. 5.7 kg	15 3/4 lbs. 7.2 kg	31 1/4 lbs. 14 kg
60	12 oz. 340 g	3 3/4 lbs. 1.7 kg	7 1/2 lbs. 3.4 kg	11 1/4 lbs. 5 kg	15 lbs. 6.8 kg	18 3/4 lbs. 8.5 kg	37 1/2 lbs. 17 kg
70	14 oz. 397 g	4 1/4 lbs. 1.9 kg	8 3/4 lbs. 4 kg	13 lbs. 6 kg	17 1/2 lbs. 8 kg	22 lbs 10 kg	43 3/4 lbs. 20 kg
80	1 lb. 454 g	5 lbs. 2.3 kg	10 lbs. 4.5 kg	15 lbs. 6.8 kg	20 lbs. 9 kg	25 lbs. 11.4 kg	50 lbs. 23 kg
90	1 lb. 454 g	5 1/2 lbs. 2.5 kg	11 1/4 lbs. 5 kg	17 lbs. 7.7 kg	22 1/2 lbs. 10.2 kg	28 lbs. 12.7 kg	56 1/4 lbs. 26 kg
100	1 1/4 lbs. 568 g	6 1/4 lbs. 2.8 kg	12 1/2 lbs. 5.7 kg	18 1/4 lbs. 8.5 kg	25 lbs. 11.4 kg	31 1/4 lbs. 14 kg	62 1/2 lbs. 28.4 kg

Total Alkalinity

After the total hardness is at or past the minimum acceptable level, the total alkalinity levels should be tested and adjusted if necessary. The amount of chemicals required to bring alkalinity into the proper range can be determined by using the accompanying charts and simply following the NSPI guidelines.

If the total alkalinity is less than 80 ppm, sodium bicarbonate can be used to raise the total alkalinity. Sodium carbonate can also be used, but this chemical will increase the pH substantially. Determine the total alkalinity with a test strip, then note in the chart below entitled Raising Alkalinity with Sodium Bicarbonate how much the alkalinity in parts per million (ppm) needs to be raised to bring the water into balance. The level at which alkalinity is considered balanced depends on the sanitizer being used (see NSPI Standard-Swimming Pool Table for ideal ranges for various sanitizers). For example, a test strip indicates a color mid-way between the 0 and the 80 ppm color blocks, the alkalinity value is around 40 ppm. Dichlor is being used as the sanitizer and therefore, a mid-range total alkalinity of 100 ppm is desired (see Total Alkalinity and pH section on page 9). Thus, the total alkalinity needs to be raised by 60 ppm for a 15,000-gallon (57 kL) pool. Referring to the chart directly below and correlating the appropriate column and row, 13.5 pounds (6 kg) of sodium bicarbonate needs to be added to raise the Alkalinity to 100 ppm.

Raising Alkalinity With Sodium Bicarbonate

See warnings for handling chemicals on page 25

Increase In Total Alkalinity in ppm	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal. 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
10	2 1/2 oz. 62 g	12 oz. 340 g	1 1/2 lbs. 681 g	2 1/4 lbs. 1 kg	3 lbs. 1.4 kg	3 3/4 lbs. 1.7 kg	7 1/2 lbs. 3.4 kg
20	4 3/4 oz. 135 g	1 1/2 lbs. 681 g	3 lbs. 1.4 kg	4 1/2 lbs. 2 kg	6 lbs. 2.7 kg	7 1/2 lbs. 3.4 kg	15 lbs. 6.8 kg
30	7 1/4 oz. 205 g	2 1/4 lbs. 1 kg	4 1/2 lbs. 2 kg	6 3/4 lbs. 3 kg	9 lbs. 4 kg	11 1/4 lbs. 5 kg	22 1/2 lbs. 10.2 kg
40	9 1/2 oz. 269 g	3 lbs. 1.4 kg	6 lbs. 2.7 kg	9 lbs. 4 kg	12 lbs. 5.5 kg	15 lbs. 6.8 kg	30 lbs. 13.6 kg
50	12 oz. 340 g	3 3/4 lbs. 1.7 kg	7 1/2 lbs. 3.4 kg	11 1/4 lbs. 5 kg	15 lbs. 6.8 kg	18 3/4 lbs. 8.5 kg	37 1/2 lbs. 17 kg
60	14 1/2 oz. 411 g	4 1/2 lbs. 2 kg	9 lbs. 4 kg	13 1/2 lbs. 6 kg	18 lbs. 8 kg	22 1/2 lbs. 10.2 kg	45 lbs. 20.4 kg
70	1 lb. 454 g	5 1/4 lbs. 2.4 kg	10 1/2 lbs. 4.8 kg	15 3/4 lbs. 7.2 kg	21 lbs. 9.5 kg	26 1/4 lbs. 12 kg	52 1/2 lbs. 23.8 kg
80	1 1/4 lbs. 568 g	6 lbs. 2.7 kg	12 lbs. 5.5 kg	18 lbs. 8 kg	24 lbs. 10.9 kg	30 lbs. 13.6 kg	60 lbs. 27.2 kg
90	1 1/2 lbs. 681 g	6 3/4 lbs. 3 kg	13 1/2 lbs. 6 kg	20 1/4 lbs. 9 kg	27 lbs. 12.3 kg	33 3/4 lbs. 15.3 kg	67 1/2 lbs. 30.6 kg
100	1 1/2 lbs. 681 g	7 1/2 lbs. 3.4 kg	15 lbs. 6.8 kg	22 1/2 lbs. 10.2 kg	30 lbs. 13.6 kg	37 1/2 lbs. 17 kg	75 lbs. 34 kg

If the total alkalinity is higher than 120 ppm, it is most commonly lowered using an acidic salt (sodium bisulfate). For example, a test strip reading for total alkalinity is 180 ppm. If the pool volume is 15,000-gallons (57 kL), and dichlor is the sanitizer, the ideal level is between 100 and 120 ppm. Referring to the chart *Lowering Alkalinity with Dry Acid*, 19.25 pounds (8.7 kg) of an acidic salt (sodium bisulfate) would be required to lower the total alkalinity by 80 ppm for a 15,000-gallon (57 kL) pool. An amount of acidic salt of this size will probably require five or six separate

additions, spread over two days. Retesting should be carried out after the total amount of liquid or dry acid has been added and the water has been allowed to circulate for at least two hours.

Lowering Alkalinity With Dry Acid (Sodium Bisulfate)

See warnings for handling chemicals on page 25

Decrease In Total Alkalinity in ppm	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal. 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
10	2 1/2 oz. 70.8 g	12 3/4 oz. 361 g	1 1/2 lbs. 681 g	2 1/2 lbs. 1.1 kg	3 1/4 lbs. 1.5 kg	4 lbs. 1.8 kg	8 lbs. 3.6 kg
20	5 oz. 142 g	1 1/2 lbs. 681 g	3 1/4 lbs. 1.5 kg	4 3/4 lbs. 2.2 kg	6 1/2 lbs. 3.0 kg	8 lbs. 3.6 kg	16 lbs. 7.3 kg
30	8 oz. 227 g	2 1/2 lbs. 1.1 kg	4 3/4 lbs. 2.2 kg	7 1/4 lbs. 3.3 kg	9 1/2 lbs. 4.3 kg	12 lbs. 5.4 kg	24 lbs. 10.9 kg
40	10 1/4 oz. 290 g	3 1/4 lbs. 1.5 kg	6 1/2 lbs. 3.0 kg	9 1/2 lbs. 4.3 kg	13 lbs. 6.0 kg	16 lbs. 7.3 kg	32 lbs. 14.5 kg
50	12 3/4 oz. 361 g	4 lbs. 1.8 kg	8 lbs. 3.6 kg	12 lbs. 5.4 kg	16 lbs. 7.3 kg	20 3/4 lbs. 9.4 kg	40 1/2 lbs. 18.4 kg
60	1 lb. 454 g	4 3/4 lbs. 2.2 kg	9 1/2 lbs. 4.3 kg	14 1/2 lbs. 6.7 kg	19 1/4 lbs. 8.7 kg	24 lbs. 10.9 kg	48 lbs. 21.8 kg
70	1 lb. 454 g	5 1/2 lbs. 2.5 kg	11 1/4 lbs. 5.1 kg	16 3/4 lbs. 7.6 kg	22 1/2 lbs. 10.2 kg	28 1/4 lbs. 12.8 kg	56 1/2 lbs. 25.7 kg
80	1 1/4 lbs. 567 g	6 1/2 lbs. 3.0 kg	12 3/4 lbs. 5.8 kg	19 1/4 lbs. 8.7 kg	25 1/2 lbs. 11.6 kg	32 lbs. 14.5 kg	64 lbs. 29 kg
90	1 1/2 lbs. 681 g	7 1/4 lbs. 3.3 kg	14 1/2 lbs. 6.7 kg	21 1/2 lbs. 9.8 kg	28 3/4 lbs. 13 kg	36 lbs. 16.3 kg	72 lbs. 32.7 kg
100	1 1/2 lbs. 681 g	8 lbs. 3.6 kg	16 lbs. 7.3 kg	24 lbs. 10.9 kg	32 lbs. 14.5 kg	40 lbs. 18.2 kg	80 lbs. 36.3 kg

pH

Once the total hardness and the total alkalinity have been balanced, the pH should be balanced. Like alkalinity, the amount of acid or base required to bring pH into the proper range can be determined by knowing the direction (higher or lower), the magnitude of the change desired, and using the following charts. For example, when testing a 15,000-gallon (57 kL) pool, a test strip indicates the pH is between 7.8 and 8.4 when compared with the color chart on the comparator. The estimated pH is 8.0, which is in the high range. Referring to the chart and correlating the correct column and row, 1 lb (0.45 kg) of dry acid would be needed to lower the pH to the proper range. Retesting should be done after the dry acid has been added and the water has circulated for at least two hours. To raise the pH, refer to the chart, Raising pH with Soda Ash.

Lowering pH With Dry Acid (Sodium Bisulfate)

(When pH is over 7.8, add the amount of acid indicated below, then retest)

See warnings for handling chemicals on page 25

pH Level	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal. 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
7.8 - 8.0	1 1/2 oz. 42.5 g	4 oz. 113 g	8 oz. 227 g	1 lb. 454 g	1 1/4 lbs. 568 g	1 1/2 lbs 681 g	3 lbs 1.4 kg
8.0 - 8.4	4 oz. 113 g	8 oz. 227 g	1 lb. 454 g	1 1/2 lbs. 681 g	2 lbs. 905 g	2 1/2 lbs. 1.1 kg	5 lbs. 2.3 kg
Over 8.4	8 oz. 227 g	1 lb. 454 g	1 1/2 lbs. 681 g	2 1/2 lbs. 1.1 kg	3 lbs 1.4 kg	4 lbs. 1.8 kg	7 1/2 lbs. 3.4 kg

Raising pH With Soda Ash (Sodium Carbonate)

(When pH is under 7.2, add the amount of soda ash indicated below, then retest)

See warnings for handling chemicals on page 25

pH Level	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
7.0 - 7.2	3/4 oz. 21.3 g	4 oz. 113 g	8 oz. 227 g	12 oz. 340 g	1 lb. 454 g	1 1/4 lbs. 568 g	2 1/2 lbs. 1.1 kg
6.7 - 7.0	1 1/4 oz. 35.4 g	6 oz. 170 g	12 oz. 340 g	1 lb. 454 g	1 1/2 lbs. 681 g	2 lbs. 908 g	4 lbs. 1.8 kg
Under 6.7	1 1/2 oz. 42.5 g	8 oz. 227 g	1 lb. 454 g	1 1/2 lbs. 681 g	2 lbs. 908 g	2 1/2 lbs. 1.1 kg	5 lbs. 2.3 kg

Free Chlorine Residual

Swimmer protection is of primary concern, and this depends on maintaining an adequate free chlorine residual to control the growth of bacteria and algae and to rid the water of organic contaminants.

Years of research have shown that swimmer protection can be achieved by maintaining a free available chlorine residual of 1 to 3 parts per million (ppm) in a swimming pool and 3 to 5 ppm in a spa. So, an important step in providing swimmer protection is to measure the free chlorine residual.

For water with no measurable free chlorine residual (either newly filled or existing), the water should be superchlorinated or "shocked" to ensure all bacteria and microorganisms are killed. To superchlorinate water, bring the free available chlorine level up to 10 ppm and hold that level for 4 hours.

Superchlorination Chart - Pools

Amount Needed to Introduce 10 ppm (mg/L)

See warnings for handling chemicals on page 25

Type of Chlorine	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal. 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
Sodium Hypochlorite	10 oz. 296 mL	1 3/4 qts. 1.7 L	3 1/4 qts. 3.0 L	1 1/4 gal. 4.7 L	1 2/3 gal. 6.3 L	2 gal. 7.6 L	4 gal. 15.2 L
Lithium Hypochlorite	4 oz. 113.4 g	1 1/4 lbs. 568 g	2 1/3 lbs. 1.1 kg	3 1/2 lbs. 1.6 kg	4 3/4 lbs. 2.2 kg	6 lbs. 2.7 kg	12 lbs. 5.4 kg
Dichlor	2 1/4 oz. 63.7 g	11 oz. 311 g	1 1/3 lbs. 605 g	2 lbs. 908 g	2 2/3 lbs. 1.2 kg	3 1/3 lbs. 1.5 kg	6 3/4 lbs. 3.1 kg
Calcium Hypochlorite	2 oz. 56.7 g	10 oz. 284 g	1 1/4 lbs. 568 g	2 lbs. 908 g	2 1/2 lbs. 1.1 kg	3 1/4 lbs. 1.5 kg	6 1/2 lbs. 2.9 kg

The accompanying Superchlorination Chart indicates how much of a specific chlorine type must be added to pools of different sizes to obtain a residual of approximately 10 ppm.

It is important to note that this chart—and all other charts within this booklet—will only provide a guideline for water adjustment. For example, adding a given amount of chlorine to a pool full of clean, clear water will not produce the same result as adding the same amount of chlorine to discolored pool with visible algae growth.

The only way to ensure that sufficient chlorine has been added is by starting with the recommendation from the chart, allow enough time for the chlorine to mix thoroughly (10 to 15 minutes for a spa and 2 to 4 hours for a pool), and retest the water.

For example, if sodium hypochlorite is used to superchlorinate a 10,000-gallon (38 kL) pool, 3.25 quarts (3.0 L) is most likely needed to reach superchlorination. Retest the water in 2 hours to make sure the free chlorine residual has reached 10 ppm. If calcium hypochlorite is used, 1.25 pounds (568 g) is needed to achieve the same result in a 10,000-gallon (38 kL) pool.

If the pool has been maintained regularly, another general guideline for superchlorination is to add 3 to 6 times the amount of chlorine normally added (excluding trichlor, which cannot be used to shock due to its low solubility). For example, if the addition of 0.5-gallons (1.9 L) of sodium hypochlorite is sufficient for normal chlorination, adding 1.5 to 3 gallons (5.7 to 11.4 L) would most likely provide a superchlorination level of residual.

Superchlorination will establish a measurable free chlorine residual in your pool in most cases. Superchlorination of neglected water may not produce a free chlorine residual and, therefore, will need to be superchlorinated twice or potentially more times.

Chlorination Chart - Pools

Amount Needed to Introduce 1 ppm (mg/L)

See warnings for handling chemicals on page 25

Type of Chlorine	Pool Volume						
	1,000 gal. 3.8 kL	5,000 gal. 19 kL	10,000 gal. 38 kL	15,000 gal. 57 kL	20,000 gal. 76 kL	25,000 gal. 95 kL	50,000 gal. 189 kL
Sodium Hypochlorite	1 oz. 29.6 mL	5½ oz. 163 mL	10½ oz. 310 mL	½ qt. 473 mL	⅔ qt. 631 mL	¾ qt. 710 mL	1⅔ qts. 1.6 L
Lithium Hypochlorite	½ oz. 14.2 g	2 oz. 56.7 g	4 oz. 114 g	6 oz. 170 g	½ lb. 227 g	10 oz. 283 g	1¼ lbs. 568 g
Dichlor	¼ oz. 7.1 g	1 oz. 28.3 g	2¼ oz. 63.8 g	3¼ oz. 92.1 g	4¼ oz. 120 g	5½ oz. 149 g	11 oz. 312 g
Calcium Hypochlorite	¼ oz. 7.1 g	1 oz. 28.3 g	2 oz. 56.7 g	3 oz. 85 g	4 oz. 113 g	5 oz. 142 g	10¼ oz. 290 g
Trichlor	⅛ oz. 3.5 g	¾ oz. 21.2 g	1½ oz. 42.5 g	2¼ oz. 63.8 g	3 oz. 85 g	3¾ oz. 106 g	7½ oz. 213 g

Once a free chlorine residual has been established, determine if that value falls in the 1 to 3 ppm ideal range of a pool. Swimming in pool water with a free chlorine residual up to 5 ppm is not detrimental. If the test strip reading indicates a level less than 1 ppm, refer to the accompanying *Chlorination Chart* to find recommendations on how to reach a residual near 1 ppm for various types of sanitizers and volumes of water.

For example, if calcium hypochlorite is used for a 10,000-gallon (38 kL) pool, 2 ounces (56.7 g) is needed to increase the free chlorine residual by 1 ppm, or 4 ounces (114 g) is needed to increase the residual by 2 ppm. If sodium hypochlorite is used, 10.5 liquid ounces (310 mL) is required to increase the residual by 1 ppm.

Total Bromine Residual

If bromine is used as the primary sanitizer, maintaining a total bromine residual is

the primary concern to control the growth of bacteria and algae and to rid the water of organic contaminants. (If chlorine is used as the primary sanitizer, disregard this section.)

With bromine, free and combined bromine are both effective sanitizers and therefore total bromine is the measured residual. The difference between free bromine and combined bromine is of no consequence. Swimmer protection can be achieved by maintaining an ideal total bromine residual of 3 to 5 parts per million (ppm) in a pool and 4 to 6 ppm in a spa. Since there are only two forms of bromine commonly used, they are referred to as either tablets or granular bromine.

Just as with chlorine, it is also important to recognize when there is no total bromine present in the water. If there is no total bromine present, a shock treatment (similar to chlorine systems) is required. Typically, a non-chlorine shock called monopersulfate is used to shock bromine pools or spas. However, the monopersulfate shock does not increase the level of bromine, so the dosage is not calculated the same way. Unlike chlorine, monopersulfate does not act as a sanitizer. It is used as an oxidant only for a shock treatment. The Non-Chlorine Shock Chart indicates the amount of monopersulfate needed. For example, if a 15,000-gallon pool (57 kL) has no measurable bromine, 1.5 lbs of monopersulfate needs to be added. Keep in mind that shocking with monopersulfate does not increase the bromine level. Therefore, bromine will need to be added in order to bring the level up post shock.

Bromine Treatment Chart

Amount Needed to Introduce 1 ppm (mg/L)
See warnings for handling chemicals on page 25

Type of Bromine	Pool Volume					
	500 gal 1.9 kL	1,000 gal 3.8 kL	5,000 gal 19 kL	10,000 gal 38 kL	15,000 gal 57 kL	25,000 gal 95 kL
Bromine Tablets*	0.05 oz 1.6 g	0.1 oz 3 g	0.5 oz 16 g	1 oz 32 g	1.5 oz 46 g	2.5 oz 80 g
Granular Bromine	0.15 oz 5 g	0.3 oz 10 g	1.5 oz 48 g	3 oz 96 g	4.5 oz 144 g	7.5 oz 240 g

* One bromine tablet is approximately 0.5 oz. in weight.

Non-Chlorine Shock Chart (Monopersulfate)

Amount Needed to Introduce Approximately 12 ppm (mg/L)
See warnings for handling chemicals on page 25

	Pool Volume					
	500 gal 1.9 kL	1,000 gal 3.8 kL	5,000 gal 19 kL	10,000 gal 38 kL	15,000 gal 57 kL	25,000 gal 95 kL
Powder Monopersulfate	0.8 oz 23 g	1.6 oz 46 g	8 oz 227 g	1 lb 454 g	1 1/2 lbs 681 g	2 1/2 lbs 1.1 kg

Cyanuric Acid

Cyanuric acid (also referred to as conditioner or stabilizer), is the chemical that protects chlorine from the degrading effects of the sun's ultraviolet (UV) rays. If the chlorine type used is dichlor or trichlor, no further cyanuric acid needs to be added as these sanitizers contain cyanuric acid in addition to chlorine. The IAF/NSPI

standard for cyanuric acid concentration in pool water recommends a minimum of 10 ppm with an ideal range of 30-50 ppm and a maximum of 150 ppm. However, some health authorities often set a maximum of 100 ppm for public pools and spas.

Establishing or Increasing Cyanuric Acid Level

See warnings for handling chemicals on page 25

Increase in Cyanuric Acid in ppm	Pool Volume						
	1,000 gal. / 3.8 kL	5,000 gal. / 19 kL	10,000 gal. / 38 kL	15,000 gal. / 57 kL	20,000 gal. / 76 kL	25,000 gal. / 95 kL	50,000 gal. / 189 kL
10	1 1/4 oz. / 35.4 g	6 1/2 oz. / 184 g	12 3/4 oz. / 361 g	1 1/4 lbs. / 568 g	1 2/3 lbs. / 756 g	2 lbs. / 908 g	4 lbs. / 1.8 kg
20	2 1/2 oz. / 62 g	12 3/4 oz. / 361 g	1 3/4 lbs. / 796 g	2 1/2 lbs. / 1.1 kg	3 1/3 lbs. / 1.5 kg	4 lbs. / 1.8 kg	8 1/3 lbs. / 3.8 kg
30	4 oz. / 113 g	1 1/4 lbs. / 568 g	2 1/2 lbs. / 1.1 kg	3 3/4 lbs. / 1.7 kg	5 lbs. / 2.3 kg	6 1/4 lbs. / 2.8 kg	12 1/2 lbs. / 5.6 kg
40	5 1/4 oz. / 149 g	1 2/3 lbs. / 758 g	3 1/3 lbs. / 1.5 kg	5 lbs. / 2.3 kg	6 2/3 lbs. / 3.0 kg	8 1/3 lbs. / 3.8 kg	16 2/3 lbs. / 7.5 kg
50	6 1/2 oz. / 184 g	2 lbs. / 908 g	4 1/4 lbs. / 1.9 kg	6 1/4 lbs. / 2.8 kg	8 1/3 lbs. / 3.8 kg	10 1/2 lbs. / 4.8 kg	21 lbs. / 9.5 kg

Refer to the accompanying chart, *Establishing or Increasing Cyanuric Acid Level*, to determine how much cyanuric acid is required to raise the cyanuric acid levels to 10–50 ppm based on the volume of water. For example, if the level of a newly filled 15,000-gallon (57 kL) pool is to be increased by 30 ppm of cyanuric acid, 3.75 pounds (1.7 kg) of cyanuric acid should be added.

Because health authorities are more concerned with the cyanuric acid level being too high, one should know how to reduce the concentration. The only way to reduce the concentration is to drain part or all of the water and refill. Draining and replacing half the water will result in a 50% reduction of the cyanuric acid concentration. Cyanuric acid levels cannot be lowered with an additive.

Conclusion to Pool Water Balancing

No set of water testing and adjustment guidelines can possibly cover every situation that can arise within a pool or spa. Yet, the guidelines outlined in this booklet can be a good place to start.

This booklet should provide a basic understanding of the various chemical tests used in the pool and spa industry, what each test means, and how to interpret and act on the results.

Knowing how to test and adjust water regularly will increase the ease of pool maintenance. Establishing a routine for maintaining water balance will reduce

the likelihood of major issues, improve water quality, protect the investment, and increase the enjoyment of the pool or spa.

Analyzing Test Results and Adjusting Spa Water

Introduction

The previous chapters on testing and adjusting pool water applies to spa water. The major differences between pools and spas are in the water temperature and ideal ranges. As with pools, NSPI guidelines for spas should be followed. These guidelines are provided in the accompanying chart.

Water Adjustments

IAF/NSPI Standards For Spas
(1999 Operational Parameters)

	Minimum	Ideal	Maximum
Free Chlorine, ppm	2.0	3.0 - 5.0	10.0
Combined Chlorine, ppm	None	None	0.2
pH	7.2	7.4 - 7.6	7.8
Total Alkalinity, ppm	60	80 - 100* 100 - 120**	180
TDS, ppm	300	1000 - 2000	3000
Calcium Hardness, ppm	150	200 - 400	500 - 1000+
Cyanuric Acid, ppm	10	30 - 50	150†

*(for Liquid Chlorine, Calcium Hypochlorite and Lithium Hypochlorite)
**(Dichlor and Trichlor Compounds)
†(except where limited by Health Dept. requirements often to 100 ppm)

As with pools, the level of calcium hardness must be established prior to balancing spa water. The NSPI spa recommendations and the adjustment procedures outlined in the chapter on pools should be followed to adjust calcium hardness. For spas smaller than 1,000 gallons (3.8 kL), decrease the amounts given in the hardness table in proportion to the volume of the spa. Likewise, the tables for adjusting alkalinity and pH given in the pool chapter can be followed to adjust the pH and alkalinity of a spa. Keep in mind that the ideal values for spas should be taken from the NSPI guidelines for spas. Again, for spas smaller than 1,000 gallons (3.8 kL), decrease the amounts of chemicals recommended in the appropriate tables in proportion to the volume of the spa.

Note: Concentrated muriatic acid (liquid) is not recommended for use in spas due to its high concentration. Do not add more than 1 ounce (28.3 g) of dry acid (sodium bisulfate) per 500-gallons (1.9 kL) at any one time. Additional acid may be added to the spa after circulating water with the aerator (air blower) on, and the pump turned off for 30 minutes. After 30 minutes, retest the pH levels.

Spa Volume Determination

Use the spa volume provided by the spa manufacturer to calculate the correct amounts of chemical components necessary to balance the water within the spa. If

that information is not available, contact the manufacturer or spa dealer and provide the serial number of the spa to acquire the volume for the specific model. A spa dealer may also be able to provide an estimated volume based on the length, width, and depth measurements, but it is best to find the precise volume of the spa from the manufacturer.

Draining Your Spa

The general recommendation from the NSPI Chemical Treatment and Process Committee for residential and commercial spas is that draining should be carried out every 2 to 3 months, depending on the number of people using the spa on a daily basis.

For example, divide the spa volume (in gallons) by 3. (For liters, divide the volume by 11.4 instead of 3). Then divide this quotient by the number of people using the spa per day. This final quotient is the number of days that the spa can be used before draining is necessary.

For example:

$$\frac{\text{450 gal. spa}}{3} = \frac{150}{\text{2 people/day}} = \text{75 days}$$

More frequent draining will be necessary with commercial spas.

For example:

$$\frac{\text{900 gal. spa}}{3} = \frac{300}{\text{50 people/day}} = \text{6 days}$$

Free Chlorine Residual

A spa's free chlorine level should be kept at 3 to 5 ppm (parts per million). The chart, *Chlorine Treatment – Spas*, provides the recommendations to raise the free chlorine level by 4 ppm with various chlorine additives.

For example, a 500-gallon (1.9 kL) spa, which uses dichlor, requires the addition of 0.5 oz (14.2 g) to increase the free chlorine levels by 4 ppm. If the spa has a smaller or larger volume, adjust the amounts proportionately.

For example, a 750-gallon spa has an existing free chlorine level of 1 ppm, and dichlor is the sanitizer used. The calculation for dichlor required to raise the free chlorine level to 4 ppm is on the next page:

Chlorine Treatment – Spas

To Introduce 4 ppm (mg/L)

See warnings for handling chemicals on page 25

Type of Chlorine	100 gal. 379 L	250 gal. 948 L	500 gal. 1.9 kL
Dichlor	1/10 oz. 2.8 g	1/4 oz. 7.0 g	1/2 oz. 14.2 g
Sodium Hypochlorite	2/5 oz. 11.8 mL	1 oz. 29.6 mL	2 oz. 59.1 mL
Lithium Hypochlorite	1/5 oz. 5.7 g	1/2 oz. 14.2 g	1 oz. 28.3 g

A. Desired Free chlorine level = 4 ppm
B. Test strip reading for free chlorine = 1 ppm
C. Subtract B from A to find the increase needed = 3 ppm

D. Choose any convenient column in the Chlorine Treatment- Spas Chart and find the amount needed for a 4 ppm increase. For this example the 500-gallon column was chosen. One half ounce of dichlor is required per 500 gallons = 1/2 oz.
E. Gallons from column heading used in D above = 500 Gallons
F. Volume of your spa = 750 Gallons
G. Divide F by E = $\frac{750}{500} = 1\frac{1}{2}$

H. Amount of dichlor required:
= D times C divided by A times G

$= D \times \frac{C}{A} \times G$

$= \frac{1}{2} \times \frac{3}{4} \times 1\frac{1}{2}$

$= \frac{9}{16}$ oz.

If the test strip indicates that total chlorine is higher than free chlorine, the spa requires a shock treatment (superchlorination). Consult a spa dealer if potassium monopersulfate is used to shock the spa.

Example: Using the AquaChek Select Connect test strip, the total chlorine pad produces a color corresponding to the 5 ppm color block. On the same test strip, the free chlorine color produced corresponds to the 3 ppm color block. Since the total chlorine is greater than the free chlorine, a shock treatment is required to the spa.

See the *Superchlorination Chart - Spas.*

For outdoor spas that use chlorine as a sanitizer, cyanuric acid can be used as a stabilizer, as in pools. If dichlor or trichlor are used as the chlorine source, no additional cyanuric acid needs to be added since cyanuric acid is incorporated into these sanitizers. The cyanuric acid adjustment tables given in the pool chapter can be used to adjust cyanuric acid levels in spas if the amounts are proportionately decreased for spas with a volume under 1,000-gallons (3.8 kL).

Superchlorination Chart – Spas

To Introduce 10 ppm (mg/L)

See warnings for handling chemicals on page 25

Type of Chlorine	100 gal. 379 L	250 gal. 948 L	500 gal. 1.9 kL
Dichlor	1/4 oz. 7.0 g	2/3 oz. 18.9 g	1 1/4 oz. 35.1 g
Sodium Hypochlorite	1 oz. 29.6 mL	2 1/2 oz. 74 mL	5 oz. 148 mL
Lithium Hypochlorite	2/5 oz. 11.3 g	1 oz. 28.3 g	2 oz. 56.7 g

Total Bromine Residual

If bromine is the primary sanitizer, the total bromine level in the spa should be maintained at 4 to 6 ppm (mg/L). The chart, Bromine Treatment – Spas, gives the recommendations to raise the total bromine level by 5 ppm. For example, a spa with a volume of 500-gallons (1.9 kL) using bromine tablets, requires the addition of 0.25 oz (8 g) to increase the total bromine by 1 ppm. If the spa has a smaller or larger water capacity, adjust the amounts proportionately.

Bromine Treatment Chart – Spas

Amount Needed to Introduce 1 ppm (mg/L)

See warning for handling chemicals on page 25

Type of Bromine	Spa Volume 100 gal. 379 L	250 gal. 948 L	500 gal. 1.9 kL
Bromine Tablets*	0.01 oz. 0.4 g	0.025 oz. 1 g	0.05 oz. 2 g
Granular Bromine	0.03 oz. 1 g	0.06 oz. 2.5 g	0.13 oz. 5 g

* One bromine tablet is approximately 0.5 oz. in weight.

Non-Chlorine Shock Chart – Spas

Amount Needed to Introduce Approximately 12 ppm (mg/L)

See warning for handling chemicals on page 25

	Spa Volume 100 gal. 379 L	250 gal. 948 L	500 gal. 1.9 kL
Powder Monopersulfate	0.2 oz. 4.8 g	0.4 oz. 12 g	0.8 oz. 23 g

AquaChek® Test Log

Filter Type:

Stabilizer Used:

	DATE	TIME OF DAY	FILTER RUN TIME HRS / DAY	LAST BACKWASH CYCLE	CHLORINE TYPE USED	CYANURIC ACID	TOTAL ALKALINITY	pH	FREE CHLORINE	TOTAL CHLORINE TOTAL BROMINE	TOTAL HARDNESS	TREATMENT
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
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27												
28												
29												
30												

Useful Conversations

The amounts of liquid chemicals referred to in this booklet are given in ounces and quarts. The following conversion tables are provided for your convenience

STANDARD -> METRIC CONVERSIONS						
STANDARD MEASURE		EQUIVALENT TO		PRECISE CONVERSION		APPROXIMATE CONVERSION
1 tbsp	=	3 tsp	=	14.78677 mL	≈	15 mL
1 fl oz	=	2 tbsp	=	29.57353 mL	≈	30 mL
1 cup	=	8 fl oz	=	236.58824 mL	≈	237 mL
1 pint	=	2 cups	=	473.17648 mL	≈	473 mL
1 pint	=	16 fl oz	=	473.17648 mL	≈	473 mL
1 quart	=	2 pints	=	946.35296 mL	≈	946 mL
1 gallon	=	4 quarts	=	3.7854 L	≈	3.8 L
1 gallon	=	128 fl oz	=	3.7854 L	≈	3.8 L
1 gallon = 4 quarts = 8 pints = 16 cups = 128 fl oz						

WARNINGS FOR HANDLING CHEMICALS

- Do not add chemicals when swimmers are in the water!
- Always follow chemical manufacturer's directions.
- Never mix chemicals together, particularly cal-hypo (calcium hypochlorite) with trichlor tablets (trichloro-s-triazinetrione) in erosion/feeder-type canisters. A fire and/or explosion could result.
- Always add acid to water; never add water to acid.
- Carefully add liquid or dry acid into various areas at the deep end of the pool away from ladders, skimmers, and metal parts. Alternatively, for vinyl liner, fiberglass, smaller pools, and spas, the prescribed quantity of dry acid (sodium bisulfate) should be dissolved in a 2-5 gallon plastic pail of water before adding to the pool or spa. Circulate water for at least 2 hours and retest. Several incremental additions over a 2-day period will be required for larger quantities of acid. As a general rule for pools, do not add more than 1 quart (946 mL) muriatic acid or 2.5 pounds (1.1 kg) dry acid per 10,000 gallons (38 kL) of pool water per day.
- For spas, the pump should be turned off, and the pre-dissolved acid should then be added and mixed vigorously by turning on the aeration pump (air blower). The purpose of this approach is to prevent a surge of acidic (corrosive) spa water from entering the pump and heater which could result in metal corrosion. Concentrated muriatic acid (liquid) is not recommended for use in spas because it is so highly concentrated and so little is needed. For spas, do not add more than 1 ounce (28.3 g) of dry acid per 500 gallons (1.9 kL) at any one time. After 30 minutes, retest. Additional acid may then be added to the spa.
- Muriatic acid liquid (about 30%) is concentrated and very corrosive. Dry acid (sodium bisulfate) is also very corrosive. Handle acid very carefully. Rinse plastic dispensing containers with water after use. Wear protective eyewear. Wash away spills thoroughly with water. Keep material away from children. Do not get on skin, in eyes, or on clothing. In case of contact, immediately flush eyes or skin with large amounts of water for 15 minutes. Call a physician.
- Calcium hypochlorite (granular or tablets), 10% sodium hypochlorite (liquid), and lithium hypochlorite (granular) are all very alkaline materials and the same handling precautions outlined for acids should be followed.
- Never store acids and chlorine compounds next to each other.
- All chemicals used for any purpose in or around the pool should be handled very carefully and precautions noted by the manufacturer followed.

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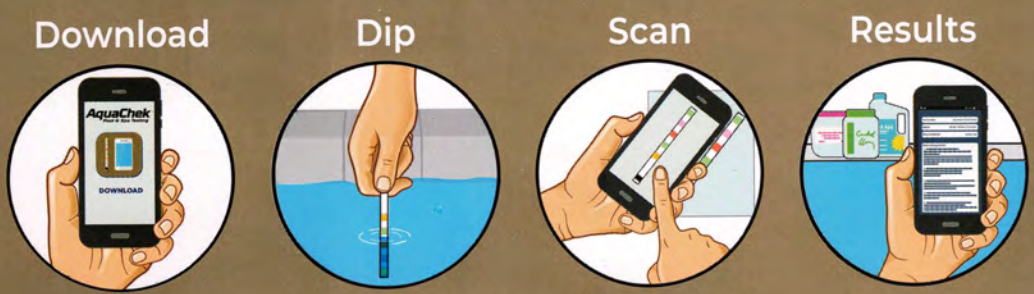
Take no chances with your pool—get expert results and treatment recommendations with **AquaChek Select® Connect**. Whether you use the free smart phone app with color matching technology or the included Complete Pool & Spa Care Guide, the expertise you need is always at your fingertips. If you need additional assistance, a detailed event report can be emailed to your local pool experts without ever leaving home.



Reusable color chart for manual testing included.

Instant, Accurate Results for 7 Chemistries

- **Total Hardness.** A proper Hardness level keeps water from causing corrosion or scaling.
- **Total Chlorine.** Knowing your Total Chlorine level will help you determine when to shock (when compared to the Free Chlorine level).
- **Total Bromine.** Keep Total Bromine levels in the ideal range to ensure clean water.
- **Free Chlorine.** An ideal level of Free Chlorine keeps water sparkling clean.
- **pH.** A proper pH level keeps water from causing corrosion or scaling.
- **Total Alkalinity.** A correct level of Total Alkalinity prevents sudden pH changes.
- **Stabilizer (Cyanuric Acid).** An ideal level of Cyanuric Acid protects against chlorine loss caused by sunlight.

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PLEASE RECYCLE

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